Hyperloop Future Directions

We have done extensive analysis of Hyperloop Alpha, with its compressor and air skis. Now we should look at alternative technologies to see if there are better solutions.

Below are a few areas that require research to progress towards a final design. We should put them in some form of sequence, and maybe look at a new topic every week or two.

In the short term we should research the options for passenger loading, analyse the energy and structural considerations, and send it to Craig Hodgetts for his Suprastudio project at UCLA. His group can use the information while studying the architectural design of the stations.
http://www.aud.ucla.edu/programs/m_arch_ii_degree_1.html

The objective for later in the year, is to finish a design that can be built as a 3-d printed model which we could present to Elon Musk. He would love it!

In some cases, if a clear decision is not obvious, we may continue with two variations, and compare them later in the design process. It it only when you complete a design that all the factors can be seen.

Tube size
The size of the tube affects the ultimate capital cost, it should be the primary consideration in any design. If we can get a 3-wide seating pod into a 2.5m tube we have done very well.

Kantrowitz compression, internal or external
Any Hyperloop concept will encounter a Kantrowitz problem at high speeds, as the speed of the gas over the pod get close to Mach 1. We need to look at the options to compress the gas, increase its density, so as to get the required mass flow. This could be internal, using a compressor, or external using thrust to compress the gas in the tube to get the mass flow.

Cooling
We need to investigate cooling, which is a problem in the vacuum tube because of the lack of heat transfer. Evaporating water to steam is good, but the steam cannot be stored due to its great volume. We could eject the steam into the tube, and pump it to condensers on the tube later. Ice would require too much weight to be carried. Possibly the heat could be radiated out to the tube wall.

Steam
We should consider the advantages of having steam (water vapour) in the tube instead of air. Steam has a higher speed of sound, and allows ejected steam cooling, but it is a disadvantage for airlock pumping

Suspension options
We have already studied air bearing skis and encountered problems with airflow. The other options are maglev and wheels. Are there any other options?

Wheel options
We should discuss the options for wheels and the options for the running surface inside the tube. The pod design is the same for all these options.
- The tube surface could be could be as-welded with a pneumatic tyre and reduced speed.
- The tube could be lined with PU for a resilient surface which is smoother than the welded tube.
- Metal wheels running on the steel tube surface, which would require full machining for accuracy.

Maglev
We should research maglev, which is difficult because there are only a couple of installed systems.

In theory, it is the ideal suspension system, but it does suffer from complexity and high cost.

Passenger loading
We have already researched side doors or end door airlocks, but we need to calculate the pumping energy which would affect the decision. We would probably not make a decision and would retain a choice of options to present to the Suprastudio guys to study.

Passenger emergency exits
We must consider ways for emergency exit from a stranded pod in the tube. It must be possible to get out and walk in either direction along the tube. There is no need for rapid evacuation like aircraft.

Traction
We need to discuss the traction options, and how they affect the journey time. If we use maglev, a linear motor system is still required. Wheels can provide the traction for normal acceleration and braking, but at a lower rate. Any system needs to provide emergency braking at about 1g.

Vacuum level
We should look at the effects of different levels of vacuum. A deeper vacuum would greatly reduce the aerodynamic drag, but would not be possible if we use ejected steam cooling.